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10/618,603	07/15/2003	Naoki Matsumoto	010986.52600US	5348

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CROWELL & MORING LLP
INTELLECTUAL PROPERTY GROUP
P.O. BOX 14300
WASHINGTON, DC 20044-4300

EXAMINER

DHINGRA, RAKESH KUMAR

ART UNIT	PAPER NUMBER
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1763

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/618,603	Applicant(s) MATSUMOTO ET AL.	
	Examiner Rakesh K. Dhingra	Art Unit 1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 May 2007.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 14, 19, 20, 22, 23, 25, 26 and 41-44 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 14, 19, 20, 22, 23, 25, 43 and 44 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date <u>05/07</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Arguments

Applicant's arguments with respect to claims 14, 15, 17, 19, 20, 22, 23, 25, 43 and 44 have been considered and response is given hereunder.

Applicant has amended claim 14 by adding limitations of claims 15 and 17, and cancelled claims 15, 17. Remaining claims have also been amended for correcting the dependency.

Accordingly claims 14,19,20,22,23,25,43 and 44 are currently active.

Further, applicant's argument regarding Ye and Tonotani references not teaching use of microwave power for meeting claim 14 limitations pertaining to chamber top wall with plurality of gas inlet holes and antenna rods penetrating the chamber side wall is found persuasive. Accordingly the previous rejection is withdrawn. However on further consideration, claim 14 is rejected under 35 USC 103 (a) over Glukhoy in view of new reference (US patent No. 5,306,379 – Kamide) and Wartski et al, since the same read on amended claim 14 limitations. In response to applicant's argument that Noguchi reference does not teach plasma apparatus where antenna penetrates chamber wall, examiner responds that as explained above with reference to claim 14, Glukhoy teaches antenna penetrating chamber side wall. Noguchi reference is used only for dependent claims 43, 44 limitation pertaining to spacing between antennas, which are taught by Noguchi (column 1, line 65 to column 2, line 15). Further, remaining claims 19, 20, 22, 23, 25, 43 and 44 have also been rejected under 35 USC 103 (a) as explained below.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter

sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 14, 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Glukhoy (US patent No. 6,783, 629) in view of Kamide (US Patent No. 5,306,379) and Wartski et al (US Patent No. 5,637,150).

Regarding Claim 14: Glukhoy teaches a plasma processing apparatus (Figures 6, 7) for supplying microwaves into a process chamber 200 so as to generate plasma P to thereby treat an object W to be processed with the plasma;

wherein the process chamber 200 comprises a top plate 36 and a chamber wall 70 for defining the process chamber; and the chamber wall has linear antennas 206, 208 (linear line) so that the antenna penetrates the chamber wall into the inside of the process chamber; and the antenna is disposed in the inside of the process chamber with respect to the top plate. Glukhoy further teaches plurality of gas tubes 42a-n, 44a-n that pass through the chamber walls near the upper wall 36 of housing 20. Glukhoy also teaches that the antenna comprises antenna tubes 208a...208n (voltage-drawing rod) for drawing a

voltage from a waveguide or resonator 230 disposed outside of the process chamber and insulating material 206a...206n surrounding the voltage-drawing rod (Figures 1, 2 and Column 5, lines 15-35 and Column 6, lines 10-30 and Column 8, lines 20-45).

Glukhoy does not teach chamber top plate with plurality of holes for passing a gas to be supplied to the process chamber and the position of the voltage drawing of the voltage-drawing rod in the waveguide corresponds to $((1+2m)/2) \lambda_{g} \pm (1/4) \lambda_{g}$, wherein λ_{g} is the guide wavelength and m is an integer) from the terminal of the waveguide.

Kamide teaches a microwave plasma apparatus (Figure 3) comprising a chamber 31, that has microwaves supplied to sides of chamber through microwave supply section 37 and the top wall has a gas showerhead 42 with plurality of holes for introducing an etching gas into the chamber.

Therefore it would have been obvious to provide plurality of gas inlet holes in the top wall of the chamber (through a gas showerhead) as taught by Kamide in the apparatus of Glukhoy et al to enable supply gas more uniformly into the wafer processing space.

Glukhoy in view of Kamide do not teach the position of the voltage drawing of the voltage-drawing rod in the waveguide corresponds to $((1+2m)/2) \lambda_{g} \pm (1/4) \lambda_{g}$, wherein λ_{g} is the guide wavelength and m is an integer) from the terminal of the waveguide.

The formula given in the claim: $\{(1+2m)/2\} \lambda_{sub.g} \pm (1/4) \lambda_{sub.g}$ when solved for integer value of m as 1, gives length of antenna as $5/4 \lambda_{sub.g}$ and $7/4 \lambda_{sub.g}$ which are odd multiples of a quarter of the guide wavelength. For other values of integer also, the antenna length would result in odd multiples of a quarter of wavelength.

Wartski et al teach a microwave plasma apparatus (Figure 1) that includes a plurality of metal antennas 5 disposed inside chamber 4 and where the length of antenna is $k \cdot \lambda / 4$ where k is an odd multiple and λ is the wavelength, which is similar to the claim formula (Column 2, lines 40-65 and Claim 2).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to maintain the position of the voltage drawing of the voltage-drawing rod (antenna length) as taught by Wartski et al in the apparatus of Glukhoy in view of Kamide to obtain optimum coupling of microwave energy with the plasma chamber.

Regarding Claim 25: Kamide teaches a susceptor 72 disposed in the chamber and connected to a bias source 44 (Figure 3).

Claims 19, 20, 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Glukhoy (US patent No. 6,783, 629) in view of Kamide (US Patent No. 5,306,379) and Wartski et al (US Patent No. 5,637,150) as applied to Claim 14 and further in view of Minaee et al (US Patent No. 6,558,635).

Regarding Claims 19, 20, 22: Glukhoy in view of Kamide and Wartski et al teach all limitations of the claims except tuner and moving of the voltage drawing rod to enable variable coupling between plasma and waveguide.

Minaee et al teach an apparatus (Figure 3) that has means for moving antenna 19 (voltage drawing rod) to enable match impedance between waveguide 26 and plasma chamber 11 (Column 4, lines 55-62 and Column 5, lines 35-42). Minaee et al further teach that the apparatus has tuning rods 35 and plate 28 for adjusting and tuning the waveguide 26 to enable antenna 19 deliver the energy to plasma chamber 11.

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use tuning and moving means of antenna as taught by Minaee et al in the apparatus of Glukhoy in view of Kamide and Wartski et al to match the impedance of the waveguide with the plasma.

Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Glukhoy (US patent No. 6,783, 629) in view of Kamide (US Patent No. 5,306,379) and Wartski et al (US Patent No. 5,637,150) as applied to Claim 14 and further in view of Totonani et al (US Patent No. 6,181,069).

Regarding Claims 19, 20, 22: Glukhoy in view of Kamide and Wartski et al teach all limitations of the claim including an observation window 34 in the upper wall 36 of the chamber to monitor state of plasma (Glukhoy – Figure 1).

Glukhoy in view of Kamide and Wartski et al do not teach a measuring device near top plate so as to monitor plasma.

Totonani et al teach a plasma apparatus (Figure 14) comprising a chamber 61 and a probe 54 (measuring device) disposed above quartz window 44 (top plate) to measure the luminous intensity of plasma (Column 13, lines 5-10).

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a measuring device near top plate of the chamber as taught by Totonani et al in the apparatus of Glukhoy in view of Kamide and Wartski et al to monitor the state of plasma.

Claims 43, 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Glukhoy (US patent No. 6,783, 629) in view of Kamide (US Patent No. 5,306,379) and Wartski et al (US Patent No. 5,637,150) as applied to Claim 14 and further in view of Noguchi (US Patent No. 6,607,633).

Regarding Claims 43,44: Glukhoy in view of Kamide and Wartski et al teaches all limitations of the claim but do not explicitly teach interval between antennas (voltage drawing rods). However it is known in the art to locate antennas at an interval of $\frac{1}{2}$ wavelength to obtain advantage of highest amplitude spots, as per an example reference cited hereunder.

For example – Noguchi teaches that slot antennas are located at $\frac{1}{2}$ *wavelength interval where the amplitude of microwave is large (column 1, line 65 to column 2, line 15).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to keep interval between antennas to be $\frac{1}{2}$ * wavelength as taught by Noguchi in the apparatus of Glukhoy in view of Kamide and Wartski et al to maximize coupling of microwave energy within the plasma chamber and obtain high density plasma with maximum plasma efficiency.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rakesh K. Dhingra whose telephone number is (571)-272-5959. The examiner can normally be reached on 8:30 -6:00 (Monday - Friday).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571)-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Rakesh Dhingra



Parviz Hassanzadeh
Supervisory Patent Examiner
Art Unit 1763